UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/768,039	02/02/2004	Miho Watanabe	118506	6320

25944 7590 12/18/2007

OLIFF & BERRIDGE, PLC
P.O. BOX 320850
ALEXANDRIA, VA 22320-4850

EXAMINER	
OLSEN, ALLAN W	
ART UNIT	PAPER NUMBER
1792	

MAIL DATE	DELIVERY MODE
12/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/768,039	WATANABE ET AL.	
	Examiner	Art Unit	
	Allan Olsen	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 October 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18,22-24,27-46,51 and 53-87* is/are pending in the application.

4a) Of the above claim(s) *1-15,31-39 and 58-87* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-18,22-24,27-30,40-46,51 and 53-57* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on October 3, 2007 has been entered.

Election/Restrictions

Claims 1-15, 32 and 67-87 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to nonelected inventions and claims 31, 33-39 and 58-66 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to nonelected species, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 16-18, 22-24, 27-30, 40-46, 51 and 53-57 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Application Publication 2002/0008956 (hereinafter, Niu) in view of WO 200245113 (hereinafter, Ito) and further in view of US Patent Application Publication 2004/0038556 of French et al. (hereinafter, French).

All references to Ito are citations to US Patent Application Publication 2004/0043219, an English language equivalent of WO 200245113.

Niu teaches forming a porous structure comprising crosslinked carbon nanotubes. See the following excerpts.

[0078] Nanofiber networks may be prepared with or without surface treatment and in various structural forms, i.e. aggregates and mats, as described below. Preferably they are treated to introduce chemical functional groups onto their surfaces. After filtration, washing and drying, the functionalized carbon nanotubes are dispersed in water and then filtered to yield a carbon nanofiber mat. After drying and **cross-linking**, a rigid carbon nanotube electrode is formed.

[0108] The electrodes may also comprise nanofibers in the form of a rigid **porous** structure comprising intertwined carbon nanofibers. The rigidity of the nanofibers are improved by causing the nanofibers to form bonds or become glued with other nanofibers at the fiber intersections. The bonding can be induced by chemical modifications of the surface of the nanofibers to promote bonding, by adding "gluing" agents and/or by pyrolyzing the nanofibers to cause fusion
or bonding at the interconnect points.

[0111] Nanofibers may be used in the electrochemical capacitors of the invention in various geometries. They may be present as dispersed fibrils, as aggregates or as mats or films.

[0128] The specific capacitance of nanotube electrodes can be further increased by surface modification. Advantageously, the nanofibers are functionalized nanofibers, i.e. nanofibers whose surfaces are uniformly or non-uniformly modified so as to have a functional chemical moiety associated therewith. The nanofiber surfaces may be functionalized by reaction with oxidizing or other chemical media. The nanofiber surfaces may be uniformly modified either by chemical reaction or by physical adsorption of species which themselves have a chemical reactivity. The nanofiber surfaces may be modified e.g. by oxidation and may be further modified by reaction with other functional groups. The nanofiber surfaces may be modified with a spectrum of functional groups so that the nanofiber can be chemically reacted or physically bonded to chemical groups in a variety of substrates.

[0129] Complex structures of nanofibers may be obtained by linking functional groups on the fibrils with one another by a range of linker chemistries.

[0130] Functionalized nanofibers and methods of making them are set forth in United States patent application Ser. No. 08/352,400 filed on Dec. 8, 1994 for FUNCTIONALIZED NANOTUBES, hereby incorporated by reference.

[0133] The nanofibers are preferably functionalized nanofibers which broadly have the formula

[C.sub.nH.sub.LR.sub.m

[0134] where n is an integer, L is a number less than 0.1 n, m is a number less than 0.5 n,

[0135] each of R is the same and is selected from SO.sub.3H, COOH, NH.sub.2, OH, O, CHO,

[0160] A network of carbon nanofibers are produced by contacting carbon fibrils with an oxidizing agent for a period of time sufficient to oxidize the surface of the carbon nanofibers, contacting the surface-oxidized carbon nanofibers with reactant suitable for adding a functional group to the surface of the carbon nanofibers, and further contacting the surface-functionalized nanofibers with a cross-linking agent effective for producing a network of carbon nanofibers. A preferred cross-linking agent is a polyol, polyamine or polycarboxylic acid.

[0161] The functionalized nanofibers may also be in the form of rigid networks of nanofibers. A well-dispersed, three-dimensional network of acid-functionalized nanofibers may, for example, be stabilized by cross-linking the acid groups (inter-fibril) with polyols or polyamines to form a rigid network.

[0162] The nanofiber particles also include three-dimensional networks formed by linking functionalized nanofibers of the invention. These complexes include at least two functionalized nanofibers linked by one or more linkers comprising a direct bond or chemical moiety.

It is noted that the limitations of claims 27, 30 and 53-57 are taught in US patent application 08/325,400 (now US Patent 6,203,814), which Niu incorporates by reference in paragraph [0130]. For example, columns 18 and 19 of the '814 patent include the following:

Activation of carboxylic acids for amination with primary amines occurs through the N-hydroxysuccinamyl ester; carbodiimide is used to tie up the water released as a substituted urea. The NHS ester is then converted at RT to the amide by reaction with primary amine.

0.242 g of chlorate-oxidized fibrils (0.62 meq/g) was suspended in 20 ml anhydrous dioxane with stirring in a 100 ml RB flask fitted with a serum stopper. A 20-fold molar excess of N-Hydroxysuccinimide (0.299 g) was added and allowed to dissolve. This was followed by addition of 20-fold molar excess of 1-ethyl-3-(3-dimethylaminopropyl)-carbodiimide (EDAC) (0.510 g), and stirring was continued for 2 hr at RT. At the end of this period stirring was stopped, and the supernatant aspirated and the solids were washed with anhydrous dioxane and MeOH and filtered on a 0.45 micron polysulfone membrane. The solids were washed with additional MeOH on the filter membrane and vacuum-dried until no further weight reduction was observed. Yield of NHS-activated oxidized fibrils was 100% based on the 6% weight gain observed.

Niu does not teach dry etching to pattern the crosslinked carbon nanotubes.

Ito teaches patterning carbon nanotube structures by masking and plasma etching. Ito teaches the mask may comprise a photoresist and/or a hard mask. Ito teaches removing the resist layer. Ito teaches the etching can be carried out by a variety of methods.. Ito explicitly teaches using oxygen radicals as well as ion beam etching. Ito teaches the ion beam etching can take place with or without a mask. See [0111] - [0127].

Ito does not teach using UV irradiation of oxygen to generate oxygen radicals.

The examiner takes Official Notice that UV irradiation of oxygen and the various excitation means taught by Ito are art recognized functionally equivalent methods of generating oxygen radicals.

With respect to patterning, it would have been obvious to one skilled in the art to use the dry etching methods taught by Ito to pattern the crosslinked carbon nanotube fibrils of Niu by because Niu teaches the fibrils have high structural stability but Niu offers no disclosure pertaining to the actual method of structuring of the fibrils. Therefore Ito's dry etching method of patterning crosslinked carbon nanotubes would facilitate Niu's vision that the fibrils can be used as electrodes in various geometries (column 12, lines 38-39) and structures (column 11, lines 29-42).

With respect to masking layer, Ito teaches the patterning of carbon nanotubes by etching through a metal mask, such as an aluminum mask. As discussed in previous Office actions, Ito also teaches the use of a resin resist in a bi-layered mask, however, Ito does not teach providing a resin mask such that the resin resist would permeate inside the holes of the inter-crosslinked, carbon-nanotube structure.

Like Ito, French teaches the use of dry etching to pattern carbon nanotubes. Furthermore, French teaches the providing the resin resist layer in direct contact with the carbon nanotubes. As such, French teaches providing the resist is such a manner that the resist would permeate inside the holes of Niu's intercosslinked nanotube structure.

It would have been obvious to substitute Ito's metal mask with a resin resist layer because French teaches using a resin resist to pattern carbon nanotubes. As such French and Ito demonstrate that a patterned metal layer and a patterned resin resist are functionally equivalent with respect to serving as a masking layer for the dry etching of carbon nanotubes.

Claims 16-18, 22-24, 27-29, 40-46 and 53-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent Application Publication 2002/0122765 of Horiuchi et al. (hereinafter, Horiuchi) in view of WO 200245113 (hereinafter, Ito) and further in view of French.

All references to paragraph numbers in Ito are citations to US Patent Application Publication 2004/0043219, an English language equivalent of WO 200245113.

Horiuchi teaches forming a structure comprising crosslinked carbon nanotubes. See, for example, paragraphs [0106] and [0137].

Horiuchi does not teach dry etching to pattern the crosslinked carbon nanotubes.

Ito teaches patterning carbon nanotube structures by masking and plasma etching. Ito teaches the mask may comprise a photoresist and/or a hard mask. Ito teaches removing the resist layer. Ito teaches the etching can be carried out by a variety of methods. Ito explicitly teaches using oxygen radicals as well as ion beam

etching. Ito teaches the ion beam etching can take place with or without a mask. See [0111] - [0127].

Ito does not teach using UV irradiation of oxygen to generate oxygen radicals.

The examiner takes Official Notice that UV irradiation of oxygen and the various excitation means taught by Ito are art recognized functionally equivalent methods of generating oxygen radicals. As such, it would have been obvious for one skilled in the art to use UV irradiation of oxygen to generate the oxygen radicals that Ito uses to etch the carbon nanotube structure.

It would have been obvious to one skilled in the art to pattern the crosslinked carbon nanotubes of Horiuchi by the dry etching methods taught by Ito because Horiuchi generally indicates that dry etching can be used to form holes or channels in the deposited material ([0214]). Horiuchi also teaches that the crosslinked carbon nanotubes can be used in various applications requiring structures that are frequently created by dry etching ([0218] - [0221]). As such it would by be obvious to use the specific teaching of Ito with respect to patterning of crosslinked carbon nanotubes to realize the general teachings of Horiuchi.

With respect to masking layer, Ito teaches the patterning of carbon nanotubes by etching through a metal mask, such as an aluminum mask. As discussed in previous Office actions, Ito also teaches the use of a resin resist in a bi-layered mask, however, Ito does not teach providing a resin mask such that the resin resist would permeate inside the holes of the inter-crosslinked, carbon-nanotube structure,

Like Ito, French teaches the use of dry etching to pattern carbon nanotubes. Furthermore, French teaches the providing the resin resist layer in direct contact with the carbon nanotubes. As such, French teaches providing the resist is such a manner that the resist would permeate inside the holes of Niu's intercosslinked nanotube structure.

It would have been obvious to substitute Ito's metal mask with a resin resist layer because French teaches using a resin resist to pattern carbon nanotubes. As such, French and Ito demonstrate that a patterned metal layer and a patterned resin resist are functionally equivalent with respect to serving as a masking layer for the dry etching of carbon nanotubes.

Response to Arguments

Applicant's arguments filed October 3, 2007 have been fully considered but they are not persuasive.

For the combination of Nui, Ito and French and for the combination of Horiuchi, Ito and French:

Applicant argues that Ito does not teach the use of a resin resist that permeates inside holes of the carbon nano-tube structure. The examiner agrees with this assessment as Ito teaches the use of a metal mask. Even with Ito's teaching of a metal/resin resist bi-layered mask, because the resin resist does not contact the carbon nanotube structure it would not be expected to permeate inside the holes of the carbon nanotube structure. Regarding French, applicant argues:

> Like Niu and Ito, French also does not teach or suggest a method of manufacturing a carbon nanotube structure, comprising (1) patterning the carbon nanotube structure layer into a desired shape (a patterning step) wherein the patterning step is a resist layer forming step of forming a resin resist layer on the region of the carbon nanotube structure layer on the base body surface that is to be patterned into a desired shape; and a removal step of removing the exposed portions of the carbon nanotube structure layer that are not covered with the resist layer by dry etching, wherein the carbon nanotube structure has a structure such that inter-crosslinking is performed, and the resin resist permeates inside holes of the structure, as recited in claim 16, or (2) patterning the carbon nanotube structure layer into a desired shape wherein the patterning step is a resist layer forming step of forming a resin resist layer on a region of the carbon nanotube structure layer on the temporary substrate surface that is to be patterned into a desired shape; and a removal step for bringing an etchant into contact with a side of the temporary substrate where the carbon nanotube structure layer and the resist layer are layered, thereby removing the carbon nanotube structure layer from the exposed regions inter-crosslinking is performed, and the resin resist permeates inside holes of the structure, as recited in claim 41.

Applicant appears to be arguing against French individually, however, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references.[1] The examiner does not rely on French for many of the features that applicant argues are not taught by French. Applicant repeatedly argues that "French does not teach or suggest a structure in which carbon nanotubes are chemically bonded with each other, as recited in the present claims". The examiner

[1] See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

does not rely upon French for this feature. This aspect of the claimed invention is taught by Nui and Horiuchi.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Allan Olsen whose telephone number is 571-272-1441. The examiner can normally be reached on M, W and F: 1-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Allan Olsen
Primary Examiner
Art Unit 1792